Electricity Review:

Variable	Unit
V (voltage)	V (volts)
R (resistance)	Ω (ohms)
I (current)	A (amps)
P (power)	W (watts)
q (charge)	C (coulombs)

Constant: k (Coulomb's constant) $= 8.99 \times 10^9\ N \cdot m^2/C^2$

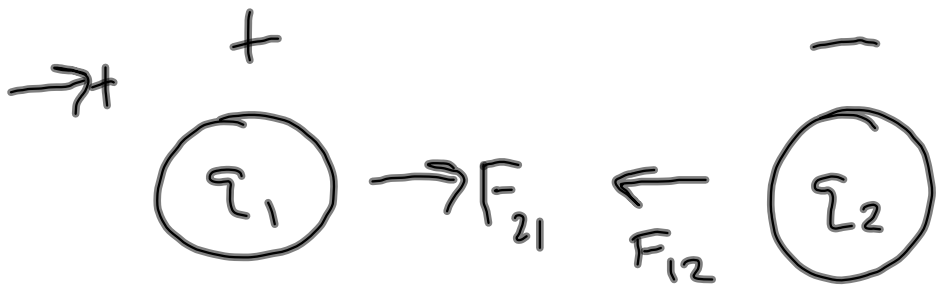
r (distance between charges)	M (meters)
F (Force)	N (newtons)
E (electric field)	N/C $\left(\frac{\text{newtons}}{\text{Coulomb}}\right)$
U_e (electric potential energy)	J (joules)
d (displacement)	M (meters)

Two charges are separated by 5 cm.

$q_1 = 60\ \mu C$

$q_2 = -45\ \mu C$

Find force between charges.



$$F_{21} = \frac{k|q_1||q_2|}{r_{12}^2}$$

$$= \frac{(8.99E9\ N\cdot m^2/C^2)(60E-6C)(45E-6C)}{(0.05\ m)^2}$$

$$= 9709\ N$$

Three charges in a line:

$q_1 = 60E-6\ C$

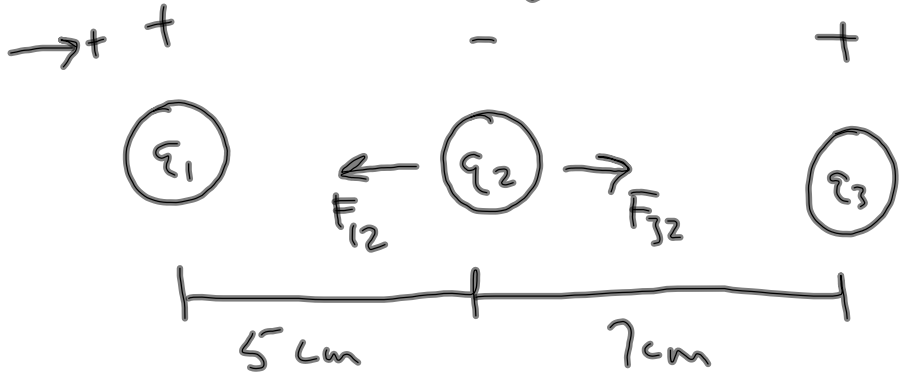
$q_2 = -45E-6\ C$

$q_3 = 75E-6\ C$

$r_{12} = 5\ cm$

$r_{23} = 7\ cm$

Find net force on q_2.



$$\Sigma \bar{F}_2 = \bar{F}_{12} + \bar{F}_{32}$$

$$= -\frac{k|q_1||q_2|}{r_{12}^2} + \frac{k|q_3||q_2|}{r_{23}^2}$$

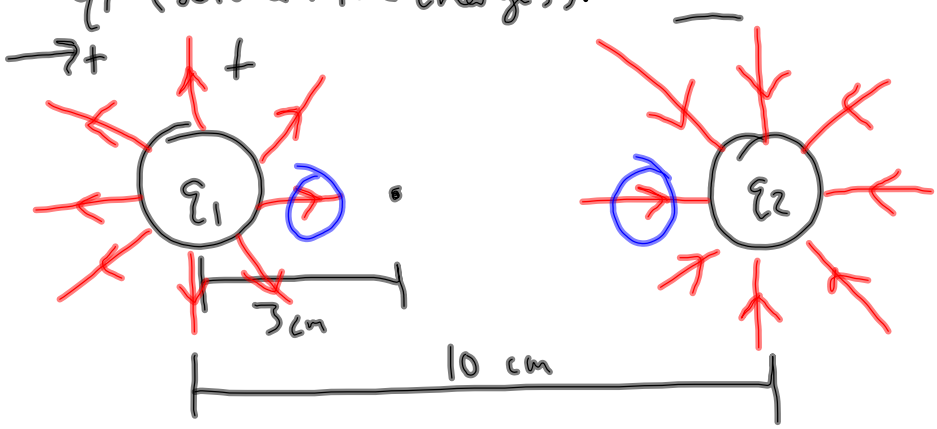
$$= \frac{-k(60E-6C)(45E-6C)}{(.05m)^2} + \frac{k(75E-6C)(45E-6C)}{(.07m)^2}$$

$$= -3517\ N$$

$q_1 = 80\ \mu C$

$q_2 = -50\ \mu C$ $\quad r_{12} = 10\ cm$

Find net electric field at point 3 cm from q_1 (between the charges).



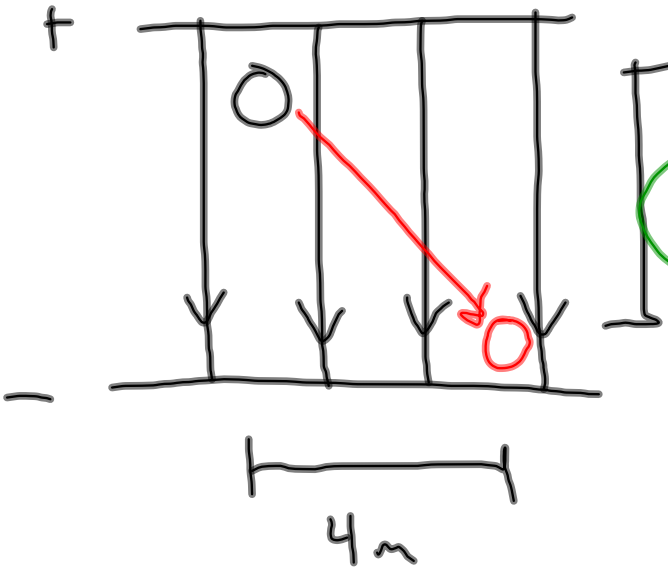
$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2$$

$$= \frac{k|q_1|}{r_1^2} + \frac{k|q_2|}{r_2^2}$$

$$= \frac{k(80E-6\,C)}{(.03\,m)^2} + \frac{k(50E-6\,C)}{(.07\,m)^2}$$

$$= 7.99E8\ N/C + 9.17E7\ N/C$$

$$= 8.91E8\ N/C$$



$q = 60E-6\ C$

$E = 10\ N/C$

Find ΔU_e

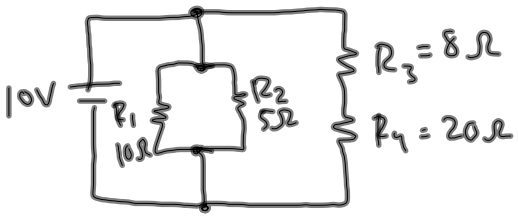
Same direction as the electric field

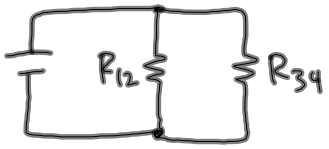
$$\Delta U_e = -qEd$$

$$= -(60E-6\ C)(10\ N/C)(5\ m)$$

$$= -0.003\ J$$

find all V's and I's





$$\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R_{12} = 3.33\,\Omega$$

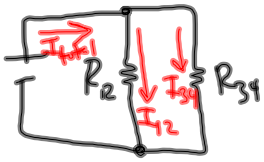
$$R_{34} = R_3 + R_4$$

$$= 28\,\Omega$$

$$\frac{1}{R_{eq}} = \frac{1}{R_{12}} + \frac{1}{R_{34}}$$

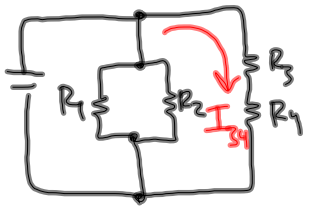
$$R_{eq} = 2.97\,\Omega$$

$$I_{total} = \frac{V_{battery}}{R_{eq}} = \frac{10\,V}{2.97\,\Omega} = 3.35\,A$$



$$I_{12} = \frac{V_{battery}}{R_{12}} = \frac{10V}{3.33\,\Omega} = 3A$$

$$I_{34} = \frac{V_{battery}}{R_{34}} = \frac{10\,V}{28\,A} = 0.357A$$



$$I_1 = \frac{10V}{R_1} = \frac{10\,V}{10\,\Omega} = \underline{1}\,A$$

$$I_2 = \frac{10\,V}{R_2} = \frac{10\,V}{5\,\Omega} = 2\,A$$

$$V_3 = I_{34} R_3 = 2.86\,V$$

$$(.357A)(8\,\Omega)$$

$$V_4 = I_{34} R_4$$

$$= (.357A)(20\,\Omega)$$

$$= 7.14\,V$$

$V_1 = 10\,V$ $\quad V_3 = 2.86\,V$

$I_1 = \underline{1}\,A$ $\quad I_3 = 0.357A$

$V_2 = 10\,V$ $\quad V_4 = 7.14V$

$I_2 = 2\,A$ $\quad I_4 = 0.357A$